Kennedy/Jenks Engineers

657 Howard Street
San Francisco, California 94105
415-362-6065

9 January 1986

Mr. Christopher M. Andrews
Manager - Engineering Quality
Control and Facilities
Airwork Corporation
Millville, NJ 08332

Subject: Additional Phase III Subsurface Investigation Report, Pacific Airmotive Corporation, Burbank, California (K/J 4101)

Dear Mr. Andrews:

The additional subsurface investigation at the Pacific Airmotive Corporation (PAC) site in Burbank, California, has been completed in accordance with our Agreement dated 13 November 1985. A soil boring (Boring 8) was drilled near the sump shed (shown on Figure 1) on 19 November 1985. The boring was drilled to collect soil samples (1) to assess the vertical extent of jet fuel migration in the vicinity of Area 2, and (2) to evaluate the potential for further jet fuel migration in this area.

This letter report summarizes field and laboratory analyses performed on the soil samples obtained from Boring 8 and presents our assessment of the potential for further migration of jet fuel at this location. The log for the soil boring is given in Attachment A and copies of the laboratory analysis reports are included in Attachment B.

SUBSURFACE SOIL INVESTIGATION

Drilling and Sampling

The soil boring location was selected outside of the limits of the previously excavated Area 2, since this area had been filled with clean backfill material. However, the sump shed and sheet piling that remained from the previous excavation of Area 2 prevented drilling as close to the sump shed as planned. Therefore, it was decided in the field at the time of drilling to reposition Boring 8 within the Area 2 excavation, near the location where elevated concentrations of jet fuel previously had been found in soil samples collected from the base of the excavation. Prior to drilling, Mr. Noel Lerner of our firm discussed the proposed subsurface investigation program and relocation of Boring 8 with Mr. David Bacharowski of the Los Angeles Regional Water Quality Control Board (RWQCB). Mr. Bacharowski concurred with the drilling methods and objectives of the subsurface investigation and with the relocation of Boring 8. Mr. Bacharowski also concurred that soil sampling need only to begin at the base of the new fill material located in Area 2 (i.e., at a depth of 30 feet).

The soil boring was drilled to a depth of approximately 83 feet utilizing a CME-55 drill rig equipped with a 6-7/8-inch diameter hollow stem auger. The boring was logged by a registered geologist and soil samples were collected at 5-foot intervals beginning at the bottom of the fill material. This material was previously placed in the Area 2 excavation during the Phase III site remediation excavation. A detailed log of the boring is presented as Attachment A.

Soil samples were collected in a 5-foot long CME Continuous Soil Core barrel fitted with two 6 in. x 2.5 in. brass liners at the bottom of the barrel for sample collection. The barrel also contained 4 feet of transparent acrylic liners above the brass liners for observing soil stratigraphy. The brass liners containing the soil samples were sealed at the ends with teflon sheeting placed between the liner caps and the soil. The liner caps were then sealed on the exterior with plastic tape, the samples marked for identification, and placed immediately in ice chests.

Soil samples were also collected from the transparent acrylic liners for headspace analysis in the field with an organic vapor analyzer (Foxboro OVA-128). Headspace analysis was performed by placing the samples in covered glass jars for 10 minutes and analyzing the headspace for the levels of organic vapors with the OVA. Chain of custody forms were completed for all soil samples submitted for analysis to Kennedy/Jenks Engineers Laboratory Division, and the samples were kept chilled during transportation to our Laboratory Division.

The drilling augers, bits, soil sampler, and sample tubes were steam cleaned prior to their initial use and between each sampling in order to reduce the likelihood of cross-contamination.

Upon completion of drilling, the boring was backfilled with a neat cement grout below 50 feet and with a sand-cement grout above 50 feet. The original asphalt surface covering was patched with an asphalt/gravel mixture.

Subsurface Conditions

The soil boring initially penetrated approximately 30 feet of clean, sandy backfill material which had been previously placed in the Area 2 excavation. This backfill showed no indication of organic vapors or fuel-containing material as was encountered while drilling below this depth.

The native sediments below the backfill are generally light colored, silty sands with gravel to two inches in diameter. The sediments are moist, rudely stratified, and dense. Although the sediments appear to be quite variable in permeability, in general they are indicative of formations with relatively high permeability values.

Immediately below the backfill material, odors indicative of organic vapors were noted in the core samples. These odors continued to be evident in soil samples until a depth of 75 feet; thereafter, a marked decline in the presence of organic odors was noted. From a depth of 75 feet to the completed depth of the boring (at 83 feet), organic odors were not detected in core samples.

Groundwater was not encountered during drilling. The estimated depth to groundwater is approximately 195 feet below the ground surface, or 120 feet below the observed vertical extent of jet fuel migration. This estimate is based on groundwater data published in the San Fernando Valley Basin Groundwater Quality Management Plan (prepared by the City of Los Angeles Department of Water and Power, dated July 1, 1983), and a survey of eleva tions of foundation slabs bordering the Area 2 excavation per formed by Rattray and Associates in June, 1985. Groundwate contours in the vicinity of the PAC site, shown on Plate 5 the Groundwater Management Plan, indicate a groundwater e tion of approximately 520 feet. (Since no datum is ref e it is assumed that elevations are referenced to Mean S (MSL).) Based on the foundation slab survey, the gr elevation at the PAC site is approximately 718 feet g- the observed vertical extent of jet fuel migration feet MSL. Thus, the difference between this elev reported groundwater elevation is approximately

confirmed
later

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Laboratory Analysis

Eight soil samples from different depths in Boring 8 were selected for laboratory analysis to confirm the vertical extent of jet fuel migration in soil remaining beneath Area 2. Laboratory analysis to determine jet fuel concentration was performed by a gas chromatography (GC) scan with a flame ionization detector (FID) using a jet fuel sample from the PAC fuel supply system as a standard. Hydrocarbon detection limits of 1 mg/Kg were achievable using this method. The gas chromatograms were also examined to determine if the relative concentrations of higher and lower molecular weight hydrocarbon fractions of the jet fuel varied with depth.

The results of the organic vapor headspace analysis performed in the field and subsequent laboratory analysis by GC scans for jet fuel are summarized in Table 1. Copies of the complete laboratory analysis reports are included in Attachment B.

Consistent with our earlier Phase I and Phase II results, there was a good relationship between headspace organic vapors detectable with the OVA and the quantitative laboratory analysis of soil samples for jet fuel. Elevated hydrocarbon vapors were present in the "shallow end" of the soil sample liner containing the sample from a depth of 74.5 to 75 feet, but not in the "deeper end" as shown in Table 1. Laboratory analysis of soil taken from the deeper end confirmed that the apparent furthest extent of jet fuel migration is currently at a depth of approximately 75 feet at Soil Boring 8.

The gas chromatograms of the four soil samples in which jet fuel was detected were compared in order to determine if the concentration of lower molecular weight hydrocarbon fractions of the jet fuel predominated at the greater depths. The GC traces were compared by determining the ratio of the GC peak areas of the lighter molecular weight fractions (early eluting peaks) with the heavier molecular weight fractions (later eluting peaks) of the jet fuel mixture. Significant variations in this ratio were not evident in any of the samples analyzed. It is therefore likely that the jet fuel has migrated to the current 75-foot depth through either gravity and/or capillary flow without significant separation of components of differing molecular weights.

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DISCUSSION

Estimated Extent of Jet Fuel Migration in Unsaturated Zone Soil

The analytical results from Soil Boring 8, together with analytical results from previous Phase I and Phase II borings, indicate that a plume of jet fuel remains in unsaturated zone soil beneath the northwest corner of the Area 2 excavation, and possibly extends laterally beneath the sump shed and Test Cell No. 4. Figure 2 shows the location of soil samples in this area which were used to identify the plume of residual jet fuel. In addition, Figure 2 shows two section lines, A-A' and B-B', for which depth profiles of jet fuel concentrations have been prepared. Figure 3 shows the concentrations of jet fuel found at depths projected on section A-A', and Figure 4 shows the concentrations of jet fuel found at depths projected on section B-B'. Also shown on Figures 3 and 4 are the estimated limits of jet fuel based on available data.

The results summarized on Figures 3 and 4 show that before the excavation of Area 2, most of the jet fuel was found within an approximate area measuring 20 feet by 25 feet extending to a depth of about 75 feet. As indicated on Figures 3 and 4, soil samples collected during Phase I and II investigations from the top 30 feet of the soil excavated from Area 2 contained the highest concentration of jet fuel detected at the site. This soil containing the highest observed concentration of jet fuel was removed during Phase III excavation to a depth of 30 feet and backfilled with clean material and paved over. The residual material is at a much lower concentration and is found below the excavated depth in an area approximately 20 feet by 25 feet by 45 feet.

Potential Mobility of Residual Jet Fuel in Unsaturated Zone Soil

A primary consideration, once the approximate vertical extent of the remaining jet fuel in the soil has been identified is the potential for further vertical migration. As presented in the following discussion, the available data on jet fuel concentrations in the soil and soil characteristics indicate that jet fuel remaining in the soil is retained at residual saturation levels and is therefore unlikely to migrate significantly to much lower depths.

When a leakage of fuel occurs in permeable soils, the fuel will migrate vertically through successive layers of the soil. As the fuel flows into a layer of soil, the fuel is initially adsorbed onto soil particles and fills micropores in the void spaces of the soil matrix. As increasing amounts of fuel flow into a soil layer, the larger voids will then fill with fuel. Eventually, when saturation levels are reached, fuel will begin to flow downwards into the underlying soil layer. However, not all of the fuel passing through the upper soils will flow downward into the underlying soil layer. The fuel remaining in the upper soil adsorbed to soil particles and retained in micropores is referred to as "residual saturation." This residual fuel is relatively immobile and is unlikely to migrate further by gravity flow or capillary action. (A detailed discussion of residual saturation pertaining to fuel spills is presented in API Publication No. 4149, The Migration of Petroleum Products in Soil and Groundwater, December 1972.)

Different hydrocarbon fuels have their own characteristic "maximum residual saturation" value. This value is normally expressed as a fraction of porosity of the soil. At or below its maximum residual saturation, jet fuel will be relatively immobile in soil since the fuel will remain adsorbed on soil particles and tightly held in micropores in the soil matrix. API (Publication No. 4149) reports typical maximum residual saturation values of 0.10 for light oil and gasoline, 0.15 for diesel and light fuel oil, and 0.20 for lube and heavy fuel oil.

A conceptual model of a plume of jet fuel, in a uniform soil column, that is no longer migrating vertically downward can be characterized by relatively constant concentrations of jet fuel throughout much of the soil column, except for a rapid concentration decrease at the bottom of the plume. The residual saturation level in the soil after migration has ceased should be at or below the maximum residual saturation value typical for the fuel and soil combination. In contrast, jet fuel that is still flowing by gravity or capillary action will have relatively constant concentrations of fuel only in the upper soil layers where the fuel remaining is at residual saturation levels and higher concentrations in lower layers where fuel is still migrating. This former condition has been found at Soil Boring 8.

To evaluate the current potential for further jet fuel migration in soil at the PAC site, the calculated saturation levels of jet

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fuel in soil samples from Boring 8 were compared with the maximum residual saturation values reported in the aforementioned API reference. Table 2 summarizes the soil porosity and soil density measurements of the soil samples from Soil Boring 8 used in estimating fuel saturation levels found in the soil. In addition, the distribution of jet fuel concentrations in soil from Boring 8 at various depths is shown on Figure 5.

Assuming that (1) the jet fuel at the PAC site is retained at residual saturation levels in the soil, and (2) an average jet fuel concentration is assumed based on Boring 8 soil samples, the calculated maximum residual saturation of 0.09 is reasonable when compared with the typical values of 0.10 to 0.15 reported by the API. The calculation was performed using the following values obtained from the analysis of soil samples from Boring 8 and an assumed jet fuel density:

- o Average jet fuel concentration, 8,600 mg/Kg;
- o Average soil porosity, 0.23;
- o Average in place soil density, 1.95 g/ml, and
- o Density of jet fuel, 0.76 g/ml.

The above values were used to calculate the amount of available pore space occupied by jet fuel and the measured residual saturation as shown below:

Volume of jet fuel in 1 Kilogram of soil:

$$\frac{8{,}600 \text{ mg jet fuel}}{\text{Kg soil}} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ ml}}{0.76 \text{ g}} = 11 \text{ ml jet fuel/Kg soil}$$

Volume of pore space in 1 Kilogram of soil (based on in-place soil density):

$$\frac{\text{ml}}{1.95 \text{ g}} \times \frac{1000 \text{ g}}{\text{Kg}} \times 0.23 \text{ (porosity)} = 120 \text{ ml pore space/Kg soil}$$

Volume of jet fuel as a fraction of porosity (residual saturation):

$$\frac{11 \text{ ml jet fuel/Kg soil}}{120 \text{ ml pore space/Kg soil}} = 0.09$$

This value compares favorably with the API reported maximum residual saturation of light fuels of 0.10 to 0.15. Therefore, it can be concluded that the jet fuel in Soil Boring 8 is at or near its residual saturation level and further significant migration should not occur by gravity or capillary flow. The jet fuel concentrations detected in samples from various depths in Boring 8 as shown on Figure 5 also support this conclusion, since fuel concentrations were similar between depths of 35 and 65 feet and dropped significantly from 65 to 75 feet (i.e., 10,000 mg/Kg at 65 feet, 4,000 mg/Kg at 74.5 feet, and <1 mg/Kg at 75 feet).

However, even if the residual saturation level for jet fuel in soil at the PAC site were less than the estimated 0.09 and limited further migration were possible, the sensitivity analysis discussed below indicates that migration through an additional 13 feet may occur. Even with this more conservative estimate utilizing a lower residual saturation level, approximately 108 feet separates groundwater from the estimated vertical extent of jet fuel migration.

The assumptions used in this conservative analysis are the following:

- o The concentration of jet fuel in soil corresponding to residual saturation levels is the lowest measured value in the main body of the plume, 7,800 mg/Kg, rather than the average of the concentrations measured at the site (8,600 mg/Kg),
- o The average concentration of jet fuel in the soil is conservatively estimated at 10,000 mg/Kg as opposed to the 8,600 mg/Kg used in previous calculations,
- o The present plume size is 20 ft x 25 ft and extends 45 feet below the base of the 30-foot excavation.

In this worst case situation, the average assumed concentration of jet fuel in soil (10,000 mg/Kg) would be above the concentration assumed for residual saturation levels (7,800 mg/Kg), so some of the jet fuel would be mobile. Because the concentration of jet fuel in soil is directly proportional to the volume of jet fuel in the soil, the assumed plume would contain 128% (10,000/7,800) of the volume of jet fuel that it can retain at residual saturation. Therefore, the column of soil must be 28%

larger in order to contain the jet fuel at maximum residual saturation. Assuming that the mobile fraction of the jet fuel in soil from depths of 30 feet to 75 feet flows downward in the soil, the calculated plume size when migration would cease would be 20 ft x 25 ft and at a depth of 88 feet, or 13 feet deeper than currently found.

Even with this conservative estimate indicating migration of jet fuel to a depth of 88 feet below the ground surface, groundwater currently lies approximately 108 feet below the estimated vertical extent of fuel migration.

There are, however, other possible pathways of jet fuel movement through soil. For instance, percolation of rainfall through the soil could leach residual jet fuel or degradation products downward through soil. However, since the entire area has been covered with asphalt paving draining away from the Area 2 excavation, percolation of rainfall should not be a significant leaching pathway.

Gas phase diffusion is another mechanism by which the lighter hydrocarbon components of jet fuel may move in soil. However, as discussed previously, the lighter fractions of jet fuel did not predominate as depth increased, indicating that vapor phase migration is apparently not a significant pathway.

Biological degradation processes may also affect residual concentrations of jet fuel in soil. These processes have been summarized by the American Petroleum Institute (API, Literature Survey: Unassisted Natural Mechanisms to Reduce Concentrations of Soluble Gasoline Components, August 1985). Studies on land farming have shown that, over time, various hydrocarbon fuels or sludges can be degraded by indigenous soil microorganisms. However, the rates of degradation were found to depend on a number of factors, including specific indigenous microbial populations, soil temperature, nutrient availability, and favorable aerobic conditions. Therefore, it is not possible to predict biological degradation rates for jet fuel in the soil but any degradation will reduce concentrations of jet fuel at the PAC site.

Additional Remediation Alternatives

Remediation activities already implemented by PAC include (1) removing fuel supply systems from the area east of Test Cell No. 4, (2) excavating soil containing jet fuel to depths of

25 feet in Area 1 and 30 feet in Area 2 and backfilling the two excavations with clean fill material, and (3) covering the entire area east of Test Cell No. 4 with new asphalt pavement. Soil leaching and soil venting are two additional potential site remediation alternatives; however, as discussed below, they do not appear to provide effective remediation benefits.

Conceptually, soil leaching relies on flushing the residual jet fuel from the soil by applying water, or other solvent, above the soil layers containing jet fuel. The jet fuel-laden water is then recovered after passing through the bottom of the soil layers containing jet fuel. Flushing has generally been considered at shallow water table sites and when complete leachate collection can be assured. However, due to the porous soils, the absence of impermeable soil formations encountered during all previous drilling at the PAC site and the great depth to groundwater, it is unlikely that the jet fuel-laden water can be recovered prior to its infiltration to underlying groundwater. Since the goal of site remediation is to prevent this from occurring, soil leaching does not appear to be a feasible alternative to reduce current residual jet concentrations in the soil at the PAC site. In fact, soil leaching would probably worsen the situation by spreading fuel deeper to groundwater or laterally.

While the porous soils are advantageous for a soil venting system, initial laboratory studies previously conducted by the Kennedy/Jenks Engineers Laboratory Division indicated that soil venting would not significantly reduce residual jet fuel concentrations in PAC site soils. During the laboratory study, air was drawn through a soil sample from the PAC site for 24 days and concentrations of fuel in the soil were measured. Jet fuel concentrations did not decrease significantly. It is likely that the lack of reduction in fuel concentrations is due to the large fraction of hydrocarbon components with high boiling points that constitute the PAC jet fuel. Laboratory analyses of fuel volatility performed by PAC's fuel supplier, Newhall Refining Co., Inc., resulted in an initial sample boil point of 324°F, a final boil point of 534°F, and distillation of 50% of the sample at 422°F.

While further excavation of soil underlying Area 2 may be considered as a potential remediation alternative, the difficulties encountered with the initial excavation to 30 feet indicate that this deeper excavation would not be feasible by the methods previously employed. The difficulties encountered with installing the sheeting to the required depths (approximately 90 feet) and the significant vibration felt inside the test cell buildings during sheeting installation indicates that structural damage may occur to nearby test cell buildings if excavation to the 75-foot depth were attempted with sheet piling. Furthermore, deeper excavation in the northwest corner of Area 2 could not occur any closer to the Test Cell No. 4 than already attempted in previous excavations.

Since it is likely that the jet fuel remaining in the soil is at or near residual saturation levels and soil leaching, soil venting, and deeper excavation alternatives are not feasible remedial alternatives at this site, the maintenance of the existing cap over the soil containing jet fuel appears to be the most feasible remediation action for this site.

CONCLUSIONS AND RECOMMENDATIONS

Based on the laboratory analysis of soil samples collected from Boring 8 and on an analysis of the amount of jet fuel estimated to occupy voids in the soil matrix, the jet fuel remaining in unsaturated zone soil at depths of 30 to 75 feet appears to be at or near residual saturation levels. Based on soil porosities and jet fuel concentrations measured in samples from Boring 8, the fraction of voids containing jet fuel is estimated to be approximately 0.09. This value is close to the maximum residual saturation values of 0.10 to 0.15 cited in the aforementioned API report on hydrocarbon fuels. Under such saturation conditions, residual fuel is retained by adsorption onto soil particles and held within micropores in the soil matrix and is not mobile by gravity or capillary flow.

Furthermore, the current estimated depth to groundwater is 115 to 120 feet below the present vertical extent of jet fuel measured in Boring 8. Even if residual saturation levels have not yet been achieved throughout the present soil column containing jet fuel, further limited migration by gravity or capillary flow should not reach groundwater, as supported by the sensitivity analysis discussed previously. Hence, it is unlikely that further significant vertical migration of jet fuel will occur beyond the additional 13 feet previously estimated as long as the paved area is maintained.

As discussed previously, soil leaching, soil venting and additional excavtion do not appear to be feasible alternatives for reducing the residual concentrations of jet fuel retained in the soil. Due to the inability to ensure recovery of water injected into the soil containing jet fuel before the water percolates down to the underlying groundwater, soil leaching is not practical and would probably worsen the situation. Since the hydrocarbons comprising the jet fuel in the site soil have limited volatility soil venting will not be effective. Additional soil excavation also does not appear feasible.

Therefore, since the residual jet fuel is unlikely to migrate through the entire depth of soil separating the current vertical extent of jet fuel and groundwater, and an asphalt cap has been placed over the area where the leak occurred, further remediation efforts do not appear warranted. We recommend that the existing cap be maintained to minimize the percolation of drainage and surface waters through the underlying soil containing jet fuel.

If you have any questions or wish to discuss these matters in greater detail, please contact us.

Very truly yours,

KENNEDY/JENKS ENGINEERS, INC.

Noel Lerner

Noel M. Lerner
Project Manager

Thomas W. Kalinowski

Thomas W. Kalinowski, Sc.D.
Assistant Manager
Industrial Services Group

NML/TWK:dnd34

Attachments

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Attachment to Kennedy/Jenks Engineers' letter report to Pacific Airmotive Corporation dated 9 January 1986

ATTACHMENT A

LOG FOR SOIL BORING 8

Figure

Kennedy/Jenks Engineers

PROJECT PACIFIC AIRMOTIVE CORPORATION

DATE 11/19/85

BY DRS

JOB NO. 4101-F-00

BORING No. 8

Details of Boring and Well Construction

SURFACE ELEVATION: NOT SURVEYED

DRILLING METHODS: CME-55 DRILL WITH 6 7/8 IN. HOLLOW STEM AUGER.

SAMPLING METHODS: CME CONTINUOUS SOIL CORE BARREL CONTAINING TWO 6 x 2.5 IN. BRASS LINERS AT BOTTOM AND 4 FT. CLEAR ACRYLIC LINERS ABOVE.

DRILLER: LAYNE - WESTERN DRILLING

SAMPLE NUMBER	SAMPLER TYPE	BLOWS/FT INTERVAL	Well Construction	DEPTH IN FEET	USCS	SYMBOLS	Description
	CONTINUOUS SOIL CORE BARREL FROM 25.0 THROUGH 83.5 FEET		NO SOIL SAMPLING DONE BETWEEN 0 AND 25 FT.	0			5 IN. NEW ASPHALT COATING
				0–25	SW		CLEAN SAND WITH GRAVEL RECENTLY PLACED BACKFILL MATERIAL, DAMP, BROWN, SAND IS ANGULAR, SIZE FROM 1/8 TO 2 MM. VERY QUARTZOSE, GRAVEL TO 1 IN. SIZE. DENSE WELL COMPACTED NONPLASTIC.
				25	SP		GRAYISH-BROWN VERY COARSE SAND WITH SILT, MOIST, DENSE TO VERY DENSE, AREA OF CEMENT SLURRY PLACED IN BOTTOM OF EXCAVATION, MINOR GRAVEL
1A	29.0						
1B	30.0			30			VERY STRONG ODOR
		N.A.					
2A	34.0						
2B	35.0			35			

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Figure

Kennedy/Jenks Engineers

PROJECT: PACIFIC AIRMOTIVE CORPORATION

JOB NO. 4101-F-00

DATE: 11/19/85

BY: DRS

BORING No. 8

Details of Boring and Well Construction

SURFACE ELEVATION: NOT SURVEYED

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SAMPLING METHODS: CME CONTINUOUS SOIL CORE BARREL CONTAINING TWO 6x2.5 IN. BRASS LINERS AT BOTTOM AND 4 FT. CLEAR ACRYLIC LINERS ABOVE.

DRILLER: LAYNE - WESTERN DRILLING

SAMPLE NUMBER	SAMPLER TYPE	BLOWS/FT-INTERVAL	DEPTH IN FEET	USCS	DESCRIPTION
				SP	
3A	39.0			GP/SP	GRAVEL WITH SAND, SANDY GRAVEL, ROCK FRAGMENTS TO 2 IN. DIA., MOIST, SAND COARSE TO FINE, GRAYISH-BROWN, NONPLASTIC, ABUNDANT MAGNETIC MATERIAL. CALCAREOUS SPOTS
3B	40.0		40		
					ROTTON GRANITIC ROCK FRAGMENTS
4A	44.0			SM	SILTY COARSE SAND WITH GRAVEL LIGHT GRAYISH COLOR, ARKOSIC, RUDE STRATIFICATION, DAMP TO MOIST, GRAVEL TO 2 IN. DIA.
4B	45.0		45		
5A	49.0				
5B	50.0		50		THIN LAYERS BLACK SAND, VERY MAGNETIC GRAINS.
		N.A.			
6A	54.0				ROTTON FELDSPATHIC AND GRANITIC MATERIAL PRESENT
6B	55.0		55		
					MATERIAL IS COMPACT / DENSE BUT PERMEABLE.
7A	59.0				
7B	60.0		60		
8A	64.0				
8B	65.0		65		SLIGHTLY FINER GRAVEL IN FINE SAND AND SILT MATRIX
9A	69.0				
9B	70.0		70		

Figure

Kennedy/Jenks Engineers

PROJECT: PACIFIC AIRMOTIVE CORPORATION

DATE: 11/19/85

JOB NO: 4101-F-00

BY: DRS

BORING No. 8

Details of Boring and Well Construction

SURFACE ELEVATION: NOT SURVEYED

DRILLING METHODS: CME-55 DRILL WITH 6 7/8 IN. HOLLOW STEM AUGER.

SAMPLING METHODS: CME CONTINUOUS SOIL CORE BARREL CONTAINING TWO 6 x 2.5 IN. BRASS LINERS AT BOTTOM AND 4 FT. CLEAR ACRYLIC LINERS ABOVE.

DRILLER: LAYNE-WESTERN DRILLING

Well Construction

SAMPLE NUMBER	SAMPLER TYPE	BLOWS/FT-INTERVAL	DEPTH IN FEET	USCS	DESCRIPTION
				SM	FINE SAND AND SILT W/ GRAVEL MOIST, GRAVEL TO 1 IN DIA ARKOSIC
10A	74.0				
10B	75.0	N.A.	75		
11A	79.0				
11B	80.0		80	GP	COARSE SAND AND GRAVEL VERY DENSE, HARD DRILLING
12A	82.5				
12B	83.5				

TOTAL DEPTH - 83.5 FT.
BOTTOM ON LARGE ROCK

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(3/85)

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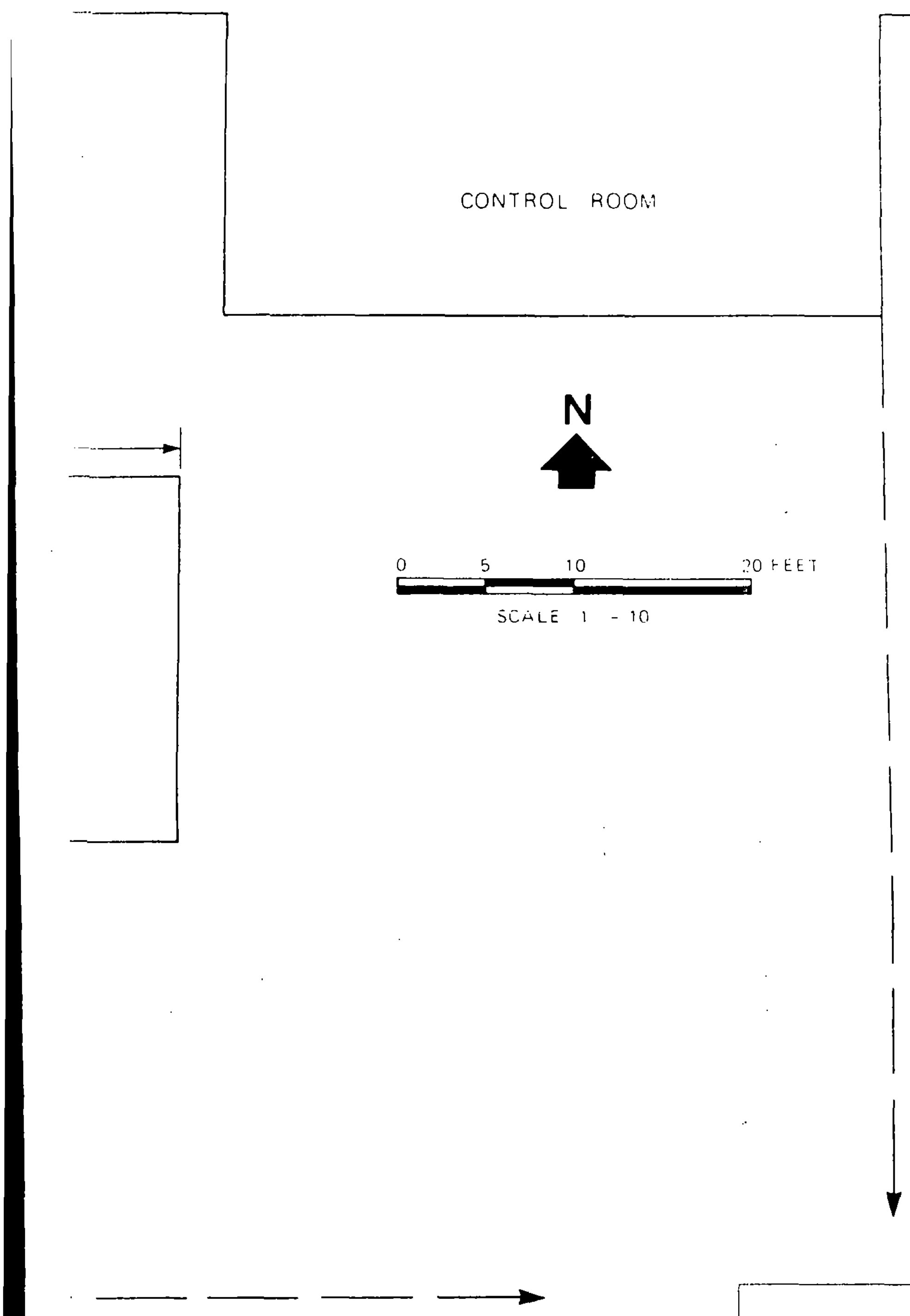


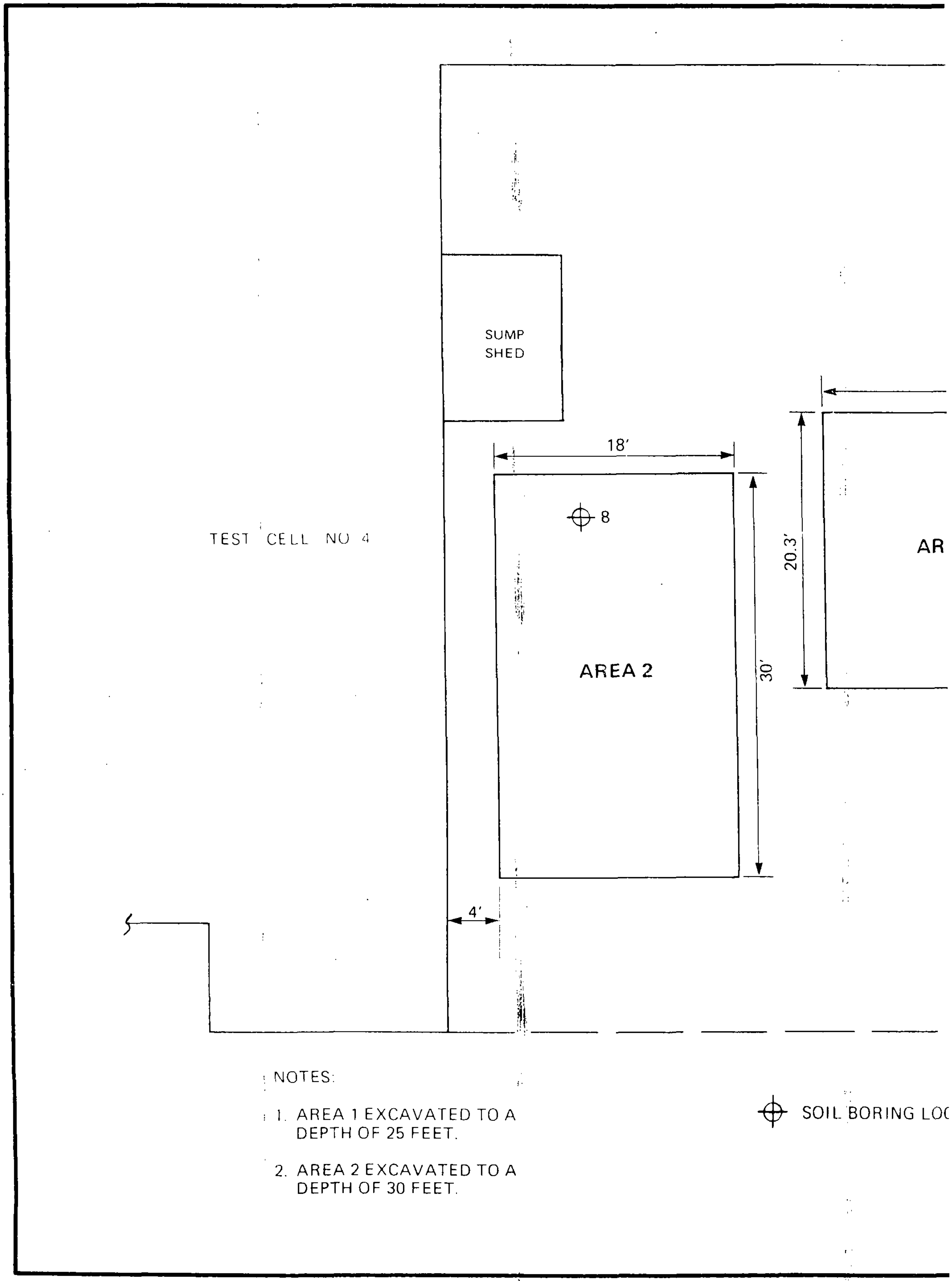
Kennedy/Jenks Engineers

Pacific Airmotive Corporation
Burbank, CA

Location of Soil Boring 8 and Excavated Areas

K/J 4101
December 1985

Figure 1



NOTES:

1. AREA 1 EXCAVATED TO A DEPTH OF 25 FEET.
2. AREA 2 EXCAVATED TO A DEPTH OF 30 FEET.

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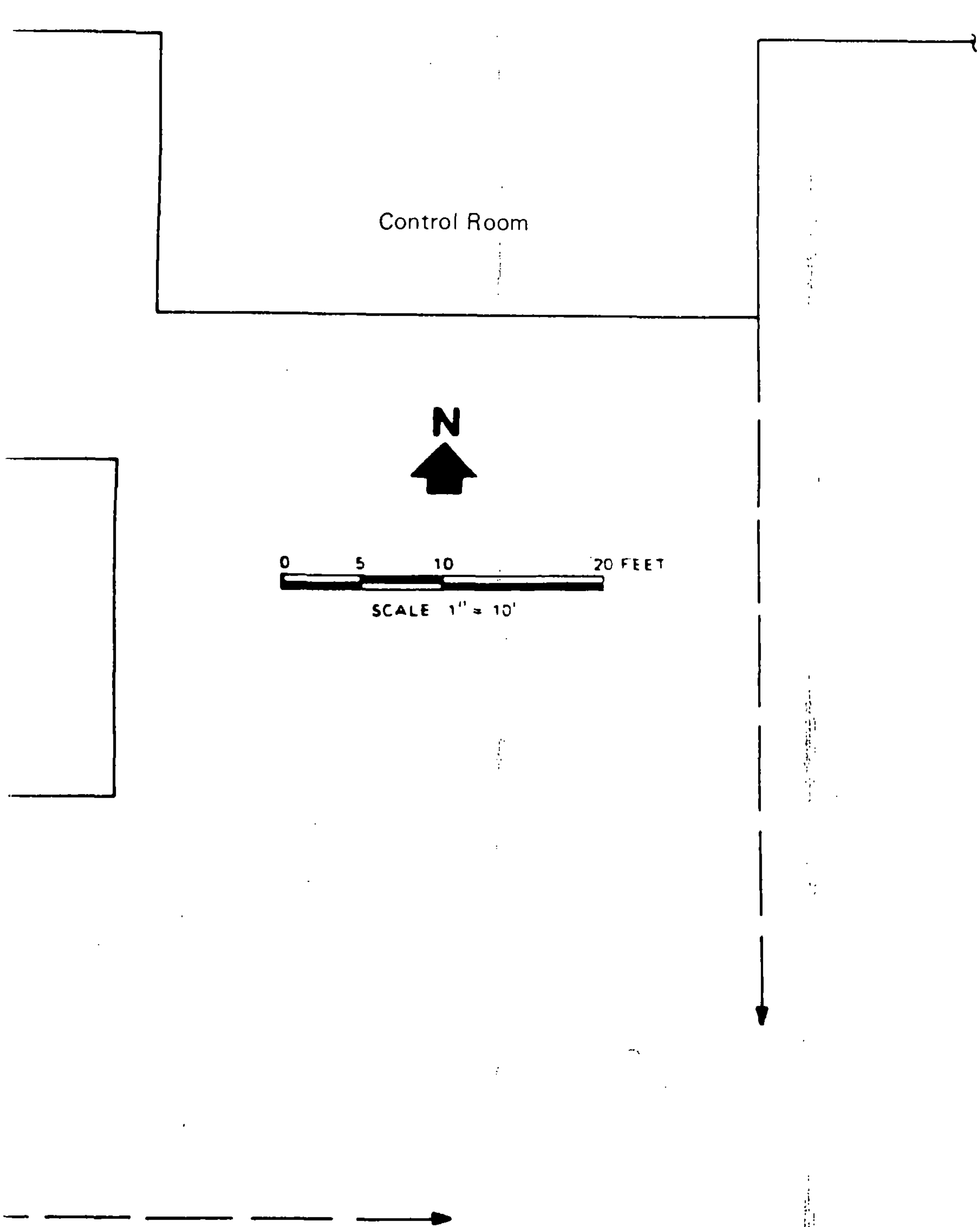

Soil samples collected during trench excavation in Phase I
Slant boring in Phase II
Grab sample in Phase II
Sample collected at bottom of excavation.
Recent vertical soil boring. (#8).

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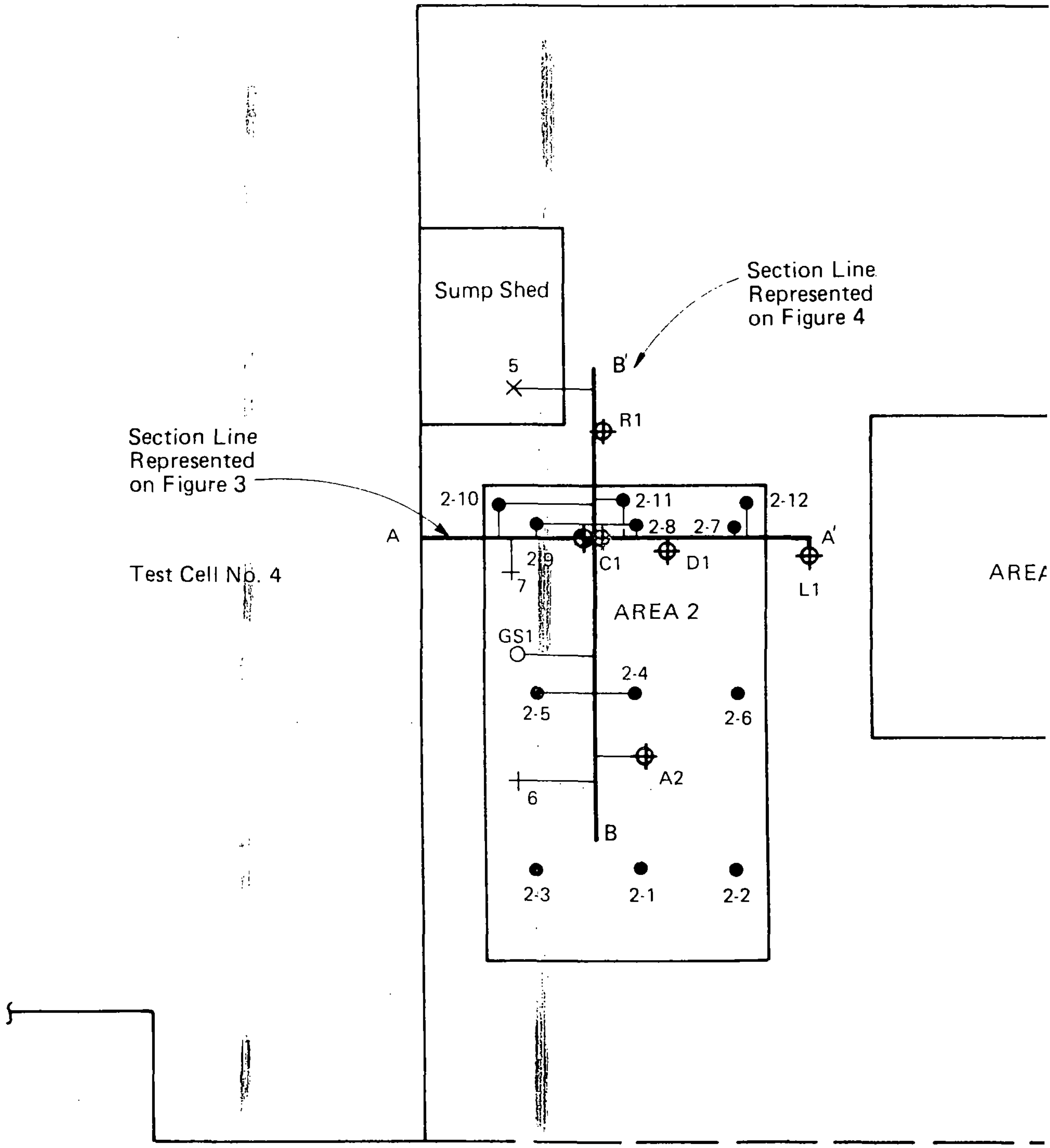
Pacific Airmotive Corporation
Burbank, CA

Approximate Locations of Soil Samples

K/J 4101
December 1985

Figure 2

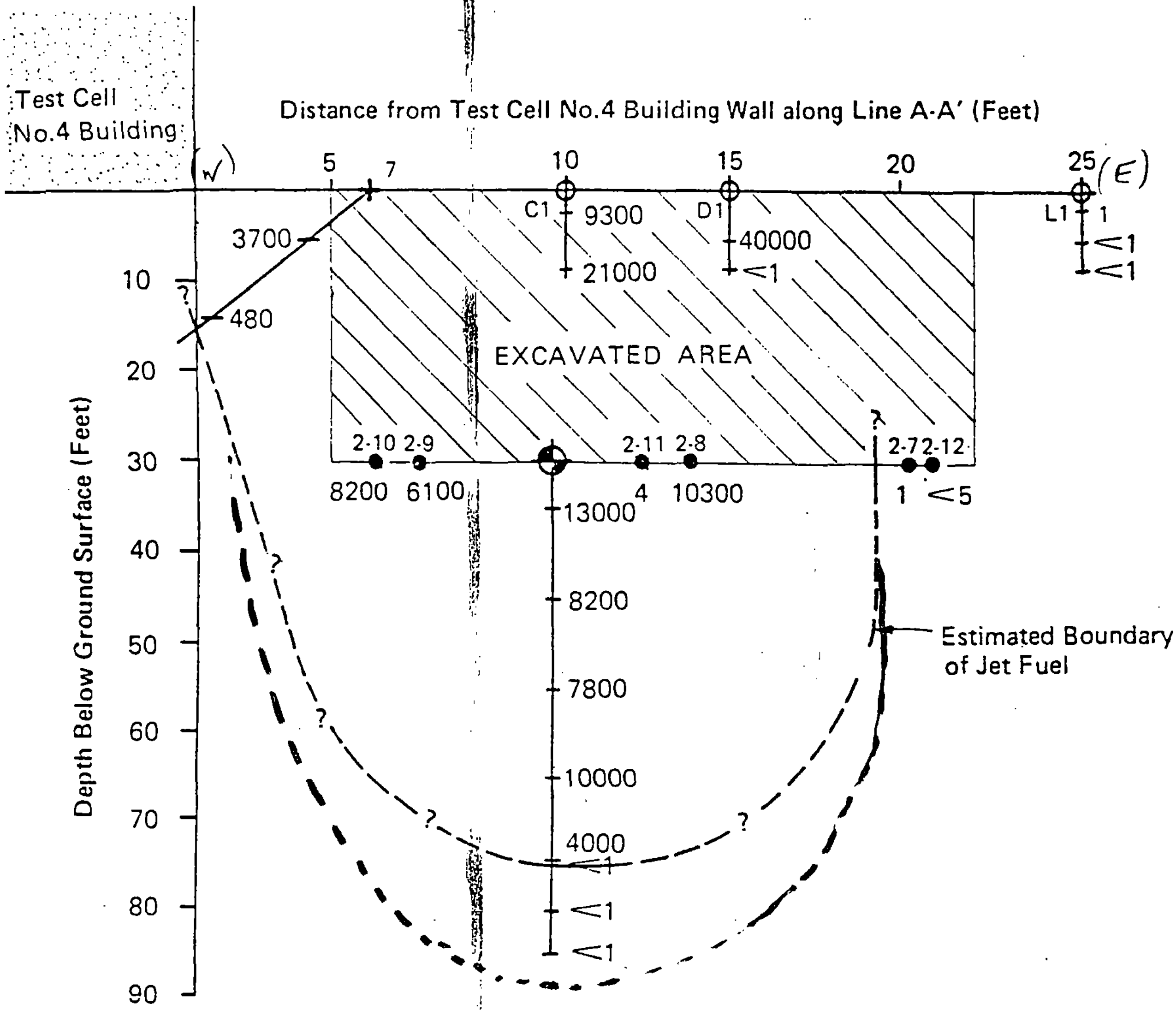


Notes:

1. Area 1 Excavated to a Depth of 25 Feet.

2. Area 2 Excavated to a Depth of 30 Feet.

Legend:



LEGEND:

- Soil samples collected during trench excavation on Phase I
- Slant boring in Phase II
- Samples collected at bottom of excavation
- Recent vertical soil boring
- 6 Soil samples designation (i.e., excavation bottom sample No. 6)

NOTE:

Jet fuel concentrations in mg/kg

- - - Estimated extent of further migration of jet fuel plume

Kennedy/Jenks Engineers

Pacific Airmotive Corporation
Burbank, CA

Jet Fuel Concentrations in Soil at Various Depths Along Line A-A'

K/J 4101
December 1985

Figure 3

Attachment to Kennedy/Jenks Engineers'
letter report to Pacific Airmotive Corporation
dated 9 January 1986

ATTACHMENT B

LABORATORY SOIL ANALYSIS REPORTS

Soil Analysis Report

Kennedy/Jenks Engineers
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

Received 11/20/85
Reported 11/26/85

For Kennedy/Jenks Engineers
Attention Noel M. Lerner
Address 657 Howard Street
San Francisco, CA 94105

Lab. No.	854361	854365	854369
Source Pacific Airmotive Corp. Burbank, CA	Soil, #8-2B, Depth 34.5-35 ft	Soil, #8-4B, Depth 44.5-45 ft	Soil, #8-6B, Depth 54.5-55 ft
Date Collected	11/19/85	11/19/85	11/19/85
Time Collected	1050	1225	1340
Collected by	Kennedy/Jenks Engineers		

Analysis	Units	Analytical Results		
Hydrocarbons (jet fuel)	mg/Kg	13,100	8,200	7,800

Comments:

(1) Analysis of extract by capillary gas chromatography, using flame ionization detection. A sample of jet fuel supplied by the client was used as comparison standard. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst ~~NI~~ Manager Leverett R. Smith

Soil Analysis Report

Kennedy/Jenks Engineers
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

Received 11/20/85

Reported 11/26/85

For Kennedy/Jenks Engineers
Attention Noel M. Lerner
Address 657 Howard Street
San Francisco, CA 94105

Lab. No.	854373	854377	854379
Source Pacific Airmotive Corp. Burbank, CA	Soil, #8-8B, Depth 64.5-65 ft	Soil, #8-10B Depth 74.5-75 ft	Soil, #8-11B Depth 79.5-80 ft
Date Collected	11/19/85	11/19/85	11/19/85
Time Collected	1445	1545	1615
Collected by	Kennedy/Jenks Engineers		

Analysis	Units	Analytical Results		
Hydrocarbons (jet fuel)	mg/Kg	10,100	<1	<1

Comments:

(1) Analysis of extract by capillary gas chromatography, using flame ionization detection. A sample of jet fuel supplied by the client was used as comparison standard. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst ~~NI~~ Manager Leverett R. Smith

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Lab. No.	854381
Source Pacific Airmotive Corp. Burbank, CA	Soil, #8-12B, Depth 82.8-83.3 ft
Date Collected	11/19/85
Time Collected	1655
Collected by	Kennedy/Jenks Engineers

Analysis	Units	Analytical Results
Hydrocarbons (jet fuel)	mg/Kg	<1

Comments:

(1) Analysis of extract by capillary gas chromatography, using flame ionization detection. A sample of jet fuel supplied by the client was used as comparison standard. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst NI Manager Leverett R. Smith

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Attention Noel M. Lerner
Address 657 Howard Street
San Francisco, CA 94105

(K/J 4101)

Lab. No.	854376
Source Pacific Airmotive Corp. Burbank, CA	Soil, #8-10A Depth 74-74.5 ft
Date Collected	11/19/85
Time Collected	1545
Collected by	Kennedy/Jenks Engineers

Analysis	Units	Analytical Results
Hydrocarbons (jet fuel)	mg/Kg	4,100

Comments:

(1) Analysis of extract by capillary gas chromatography, using flame ionization detection. A sample of jet fuel supplied by the client was used as comparison standard. Results reported in milligrams per kilogram, wet (as received) weight basis.

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(K/J 4101) Quality Control Page

Lab. No.	854379
Source Pacific Airmotive Corp. Burbank, CA	Soil, #8-11B Depth 79.5-80 ft
Date Collected	11/19/85
Time Collected	1615
Collected by	Kennedy/Jenks Engineers

Analysis	Units		Replicate	Analytical Results
Hydrocarbons (jet fuel)	mg/Kg	<1	<1	Spike recovery 73%

Comments:

(1) Analysis of extract by capillary gas chromatography, using flame ionization detection. A sample of jet fuel supplied by the client was used as comparison standard. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst NI Manager Leverett R. Smith

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Address 657 Howard Street
San Francisco, CA 94105

(K/J 4101)

Lab. No.		854363	854364	854375	854380
Source Pacific Airmotive Corp. Burbank, CA		Core soil, #8-3B, Depth 39.5-40 ft	Core soil, #8-4A, Depth 44-44.5 ft	Core soil, #8-9B, Depth 69.5-70 ft	Core soil, #8-12A, Depth 82.3-82.8 ft
Date Collected		11/19/85	11/19/85	11/19/85	11/19/85
Time Collected		1120	1225	1510	1655
Collected by		K/J			
Analysis	**Units**	**Analytical Results**			
In-place volume of sample (1)	cc	111.1	107.0	104.9	94.5
Wet sample weight (2)	g	235.71	244.25	189.31	200.13
Dried sample weight (3)	g	209.14	230.02	180.72	193.87
Percent moisture (4)	%	11.27	5.83	4.54	3.13
Specific gravity of sample (5)	-	2.59	2.54	2.57	2.58

Notes:

(1) Partially emptied core volume was lined with plastic, then filled with water. Volume calculated from weight of water used to fill space.
(2) As taken from core.
(3) Sample dried at 180°C for 3 hr.
(4) As percent of sample as received.
(5) Specific gravity obtained by displacement of water in a graduated cylinder, using the dried soil sample.

Comments:

Analyst LP Manager Leverett R. Smith

cc: D.R. Schnaible, M.T. Poulsen, K/J

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(K/J 4101)

Lab. No.		854361	854367	854373	854379
Source Pacific Airmotive Corp. Burbank, CA		Soil, #8-2B, Depth 34.5-35 ft	Soil, #8-5B, Depth 49.5-50 ft	Soil, #8-8B, Depth 64.5-65 ft	Soil #8-11B, Depth 79.5-80 ft
Date Collected		11/19/85	11/19/85	11/19/85	11/19/85
Time Collected		1050	1305	1445	1615
Collected by		K/J			
Analysis	**Units**	**Analytical Results**			
Total Organic Carbon	mg/kg (1)	6300	2100	2300	65
Moisture content	% (2)	12.1	4.0	3.7	3.8

Comments:

(1) Analysis by Dohrmann DC-52 carbon analyzer, reported in milligrams per kilogram, wet (as received) weight basis.
(2) Based on wet weight.

Analyst AD, LP Manager Leverett R. Smith

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(K/J 4101)

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Collected by		K/J			
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Total Organic Carbon	mg/kg (1)	6300	2100	2300	65
Moisture content	% (2)	12.1	4.0	3.7	3.8

Comments:

(1) Analysis by Dohrmann DC-52 carbon analyzer, reported in milligrams per kilogram, wet (as received) weight basis.
(2) Based on wet weight.

Analyst AD, LP Manager Leverett R. Smith